Fig. 1

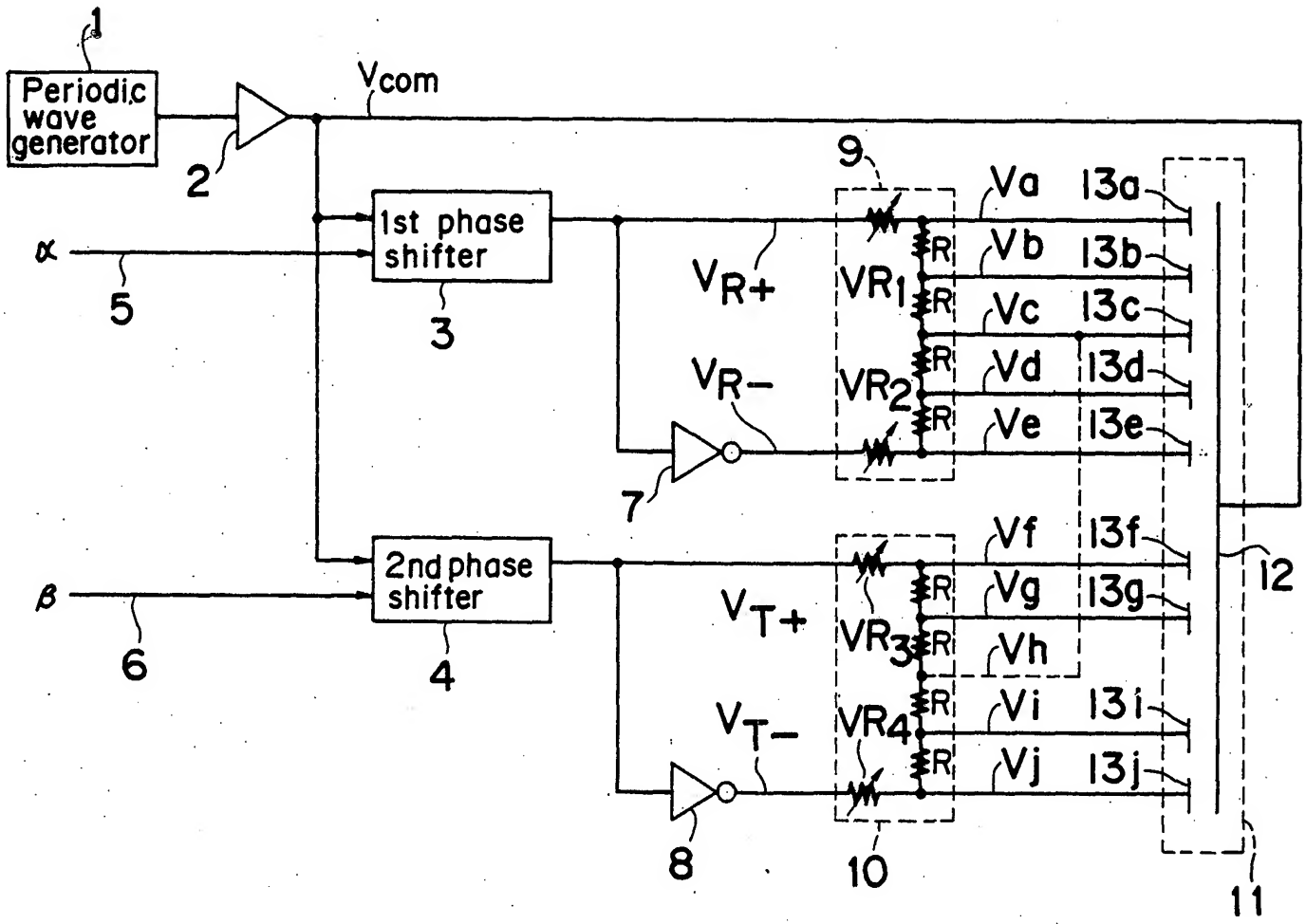
1
Periodic wave generator
2
Vcom
1st phase shifter
3
α
5
2nd phase shifter
4
β
6
7
8
9
10
11
12
R
VR+
VR−
VR1
VR2
VR3
VR4
VT+
VT−
Va
Vb
Vc
Vd
Ve
Vf
Vg
Vh
Vi
Vj
13a
13b
13c
13d
13e
13f
13g
13i
13j

Fig. 2A

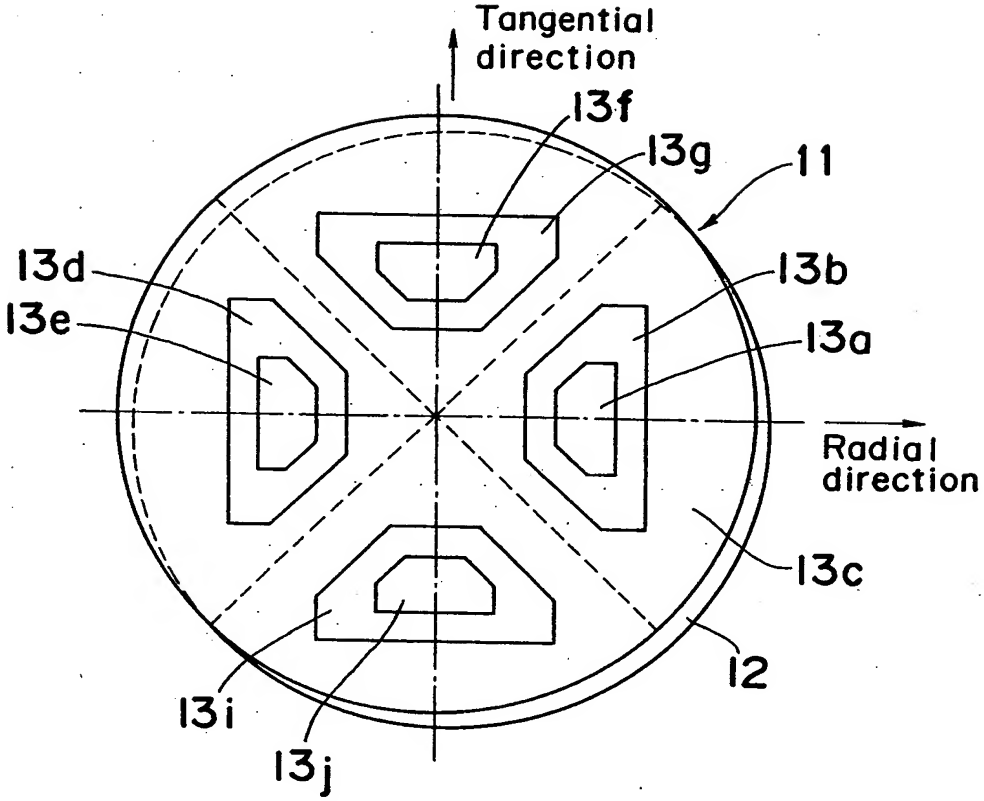
Tangential direction
13f
13g
11
13d
13e
13b
13a
Radial direction
13c
12
13i
13j

Fig. 2B

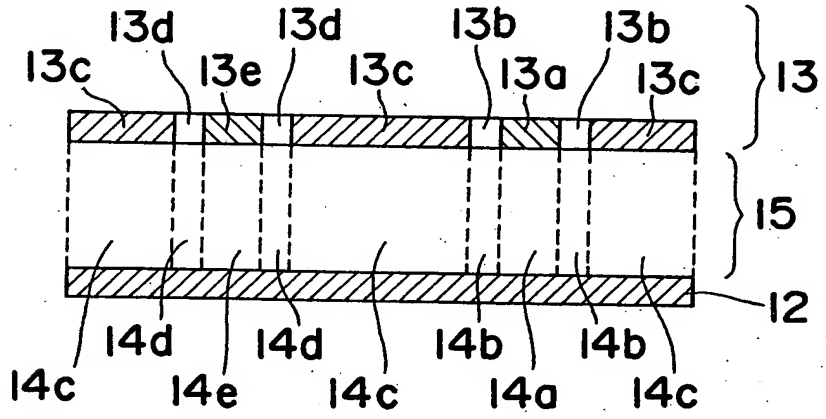
13d
13d
13b
13b
13c
13e
13c
13a
13c
13
15
12
14d
14d
14b
14b
14c
14e
14c
14a
14c

Fig. 3A

$\theta = 90°$, $\alpha = 0°$

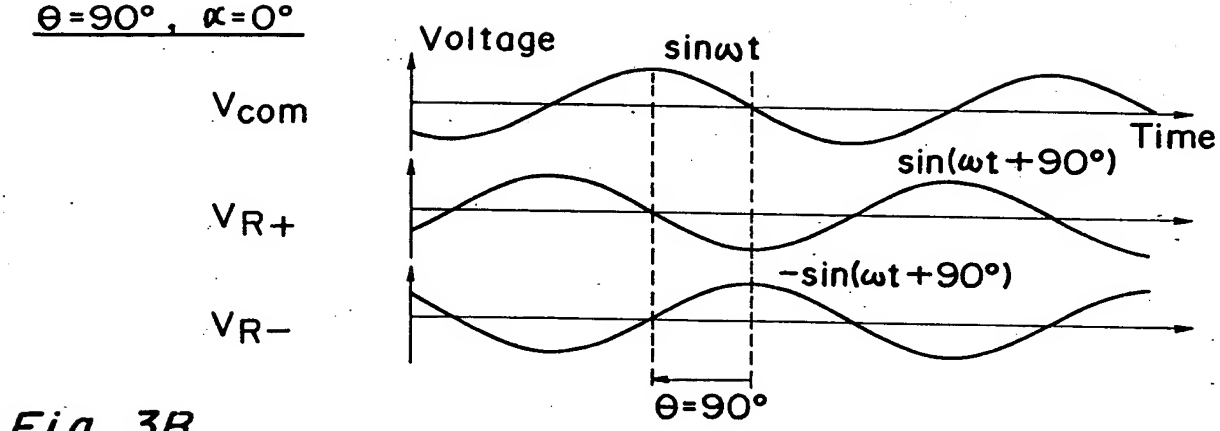

Fig. 3B

$\theta = 90°$, $\alpha = 45°$

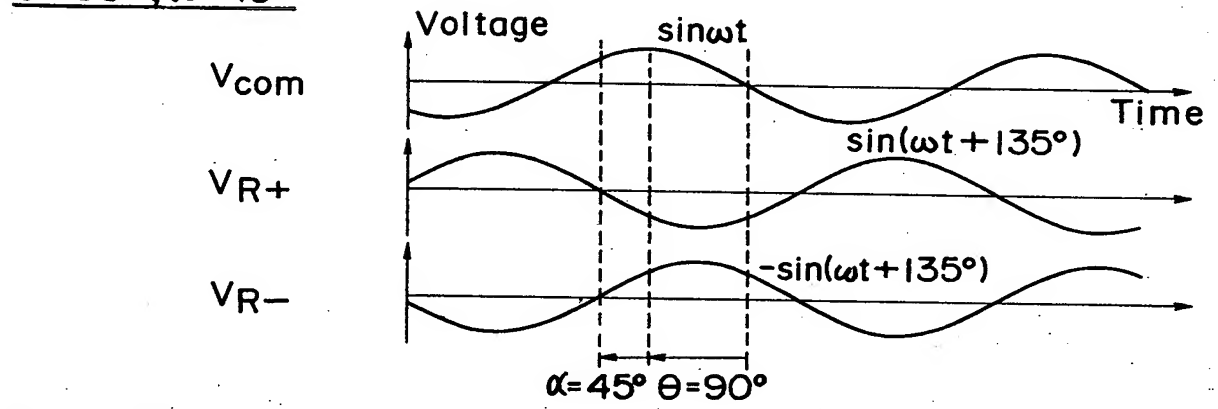

Fig. 3C

$\theta = 90°$, $\alpha = 90°$

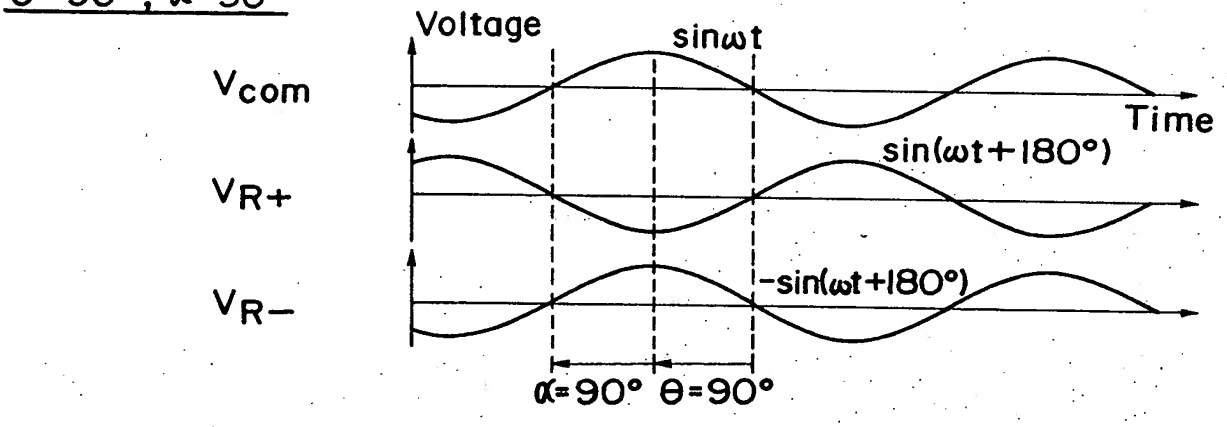

Fig.4A

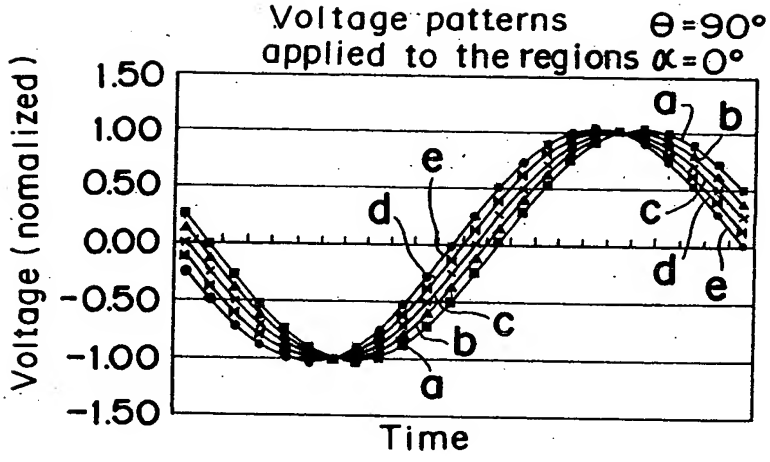

Fig.4B

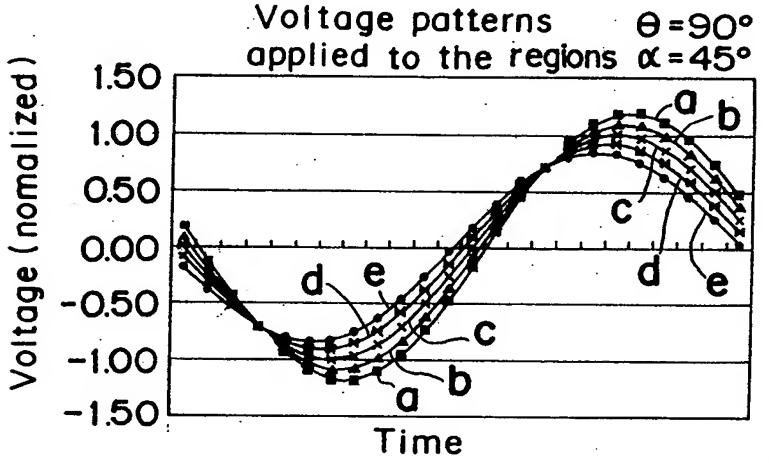

Fig.4C

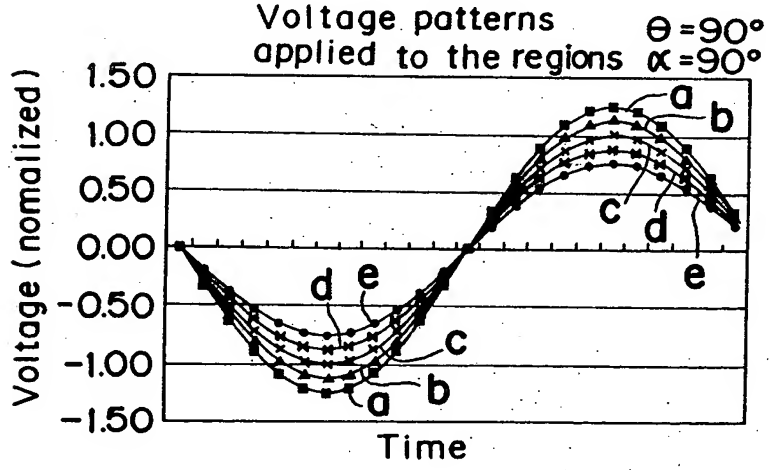

Fig.5

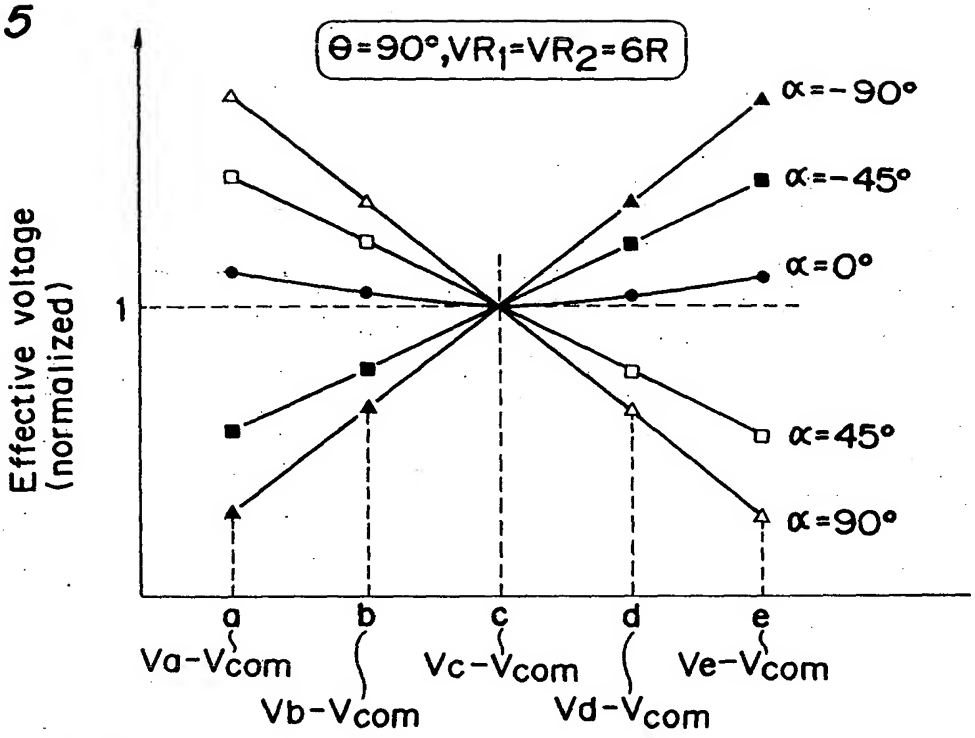
θ=90°,VR1=VR2=6R
α=-90°
α=-45°
α=0°
α=45°
α=90°
Effective voltage (normalized)
1
a
b
c
d
e
Va-Vcom
Vb-Vcom
Vc-Vcom
Vd-Vcom
Ve-Vcom

Fig.6

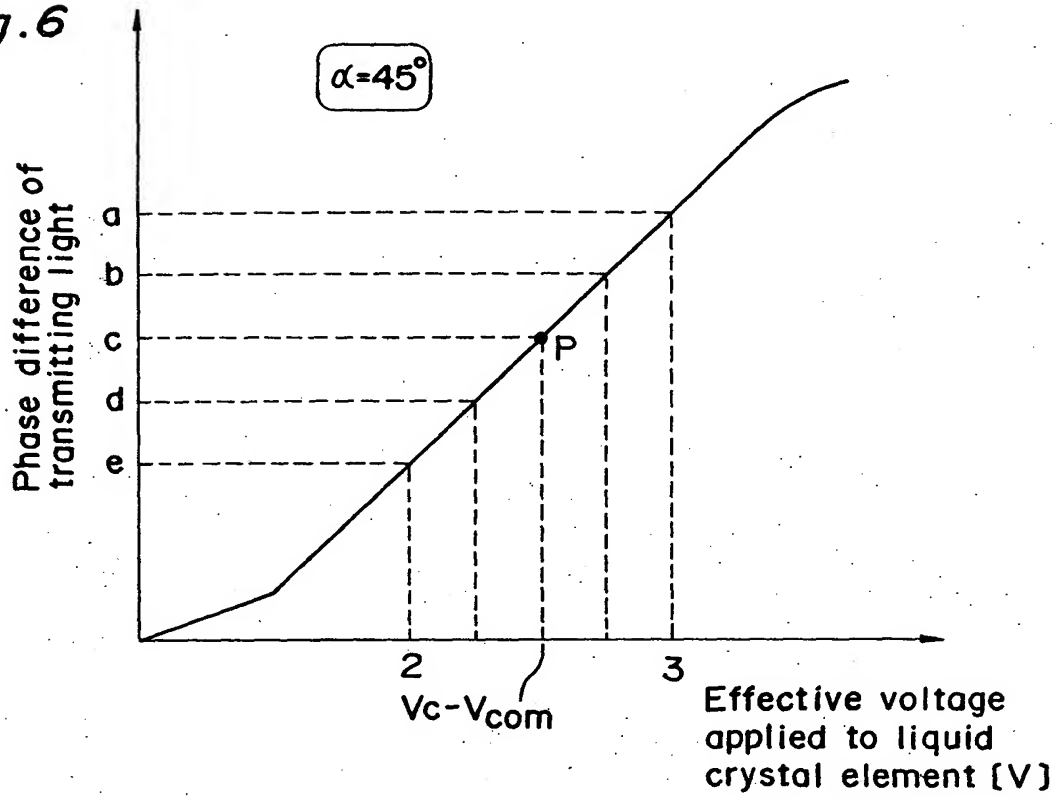
α=45°
Phase difference of transmitting light
a
b
c
d
e
P
2
3
Vc-Vcom
Effective voltage applied to liquid crystal element [V]

Fig. 7

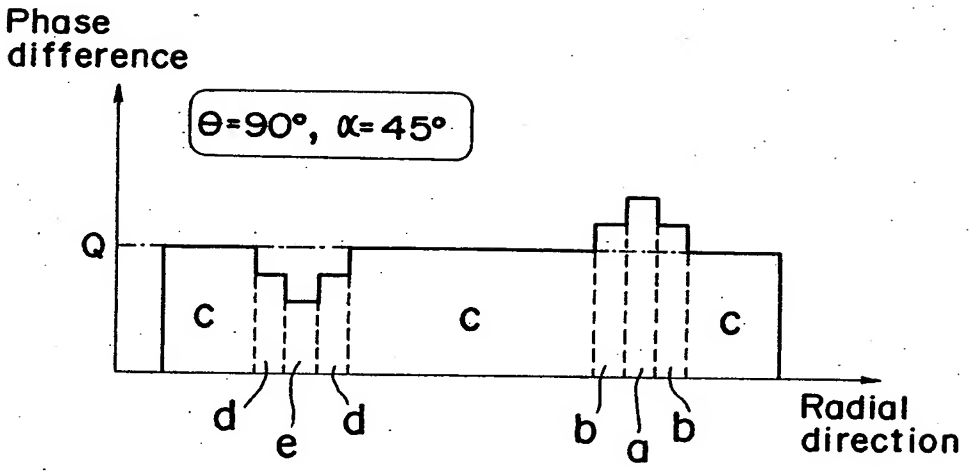
Phase difference
Θ=90°, α=45°
Q
c
c
c
d
e
d
b
a
b
Radial direction

Fig. 8

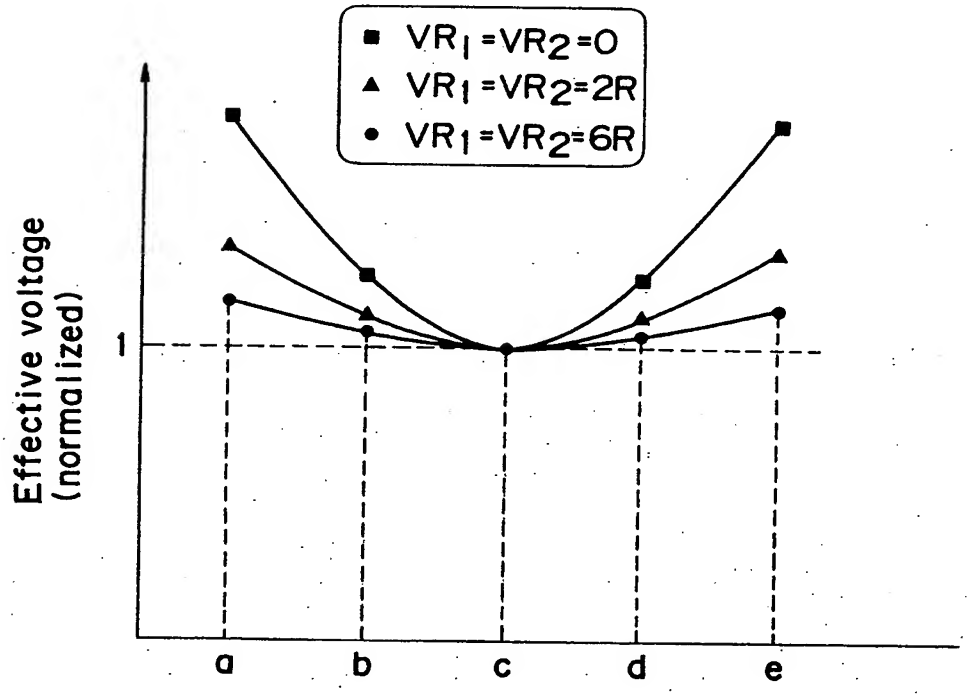
VR1=VR2=0
VR1=VR2=2R
VR1=VR2=6R
Effective voltage (normalized)
1
a
b
c
d
e

Fig. 9

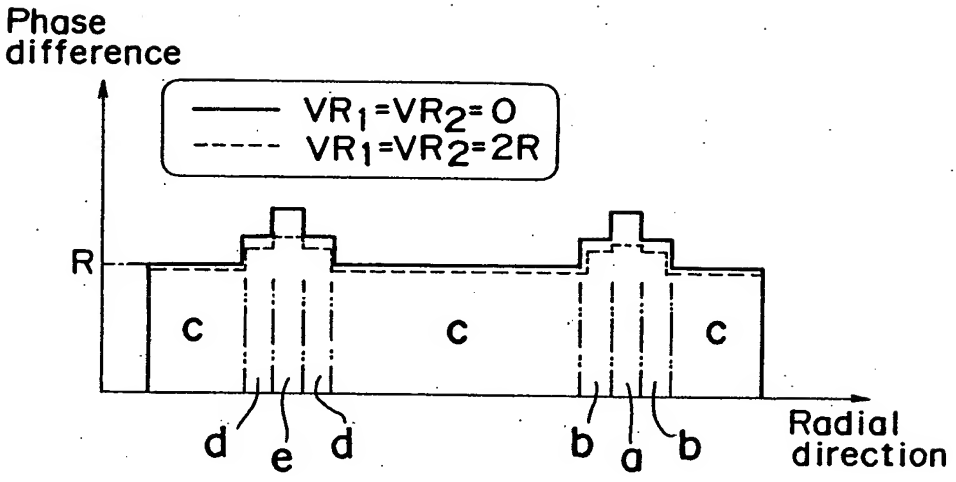
Phase difference
VR1=VR2=0
VR1=VR2=2R
R
c
c
c
d
e
d
b
a
b
Radial direction

Fig. 10A

θ=90°, α=0°

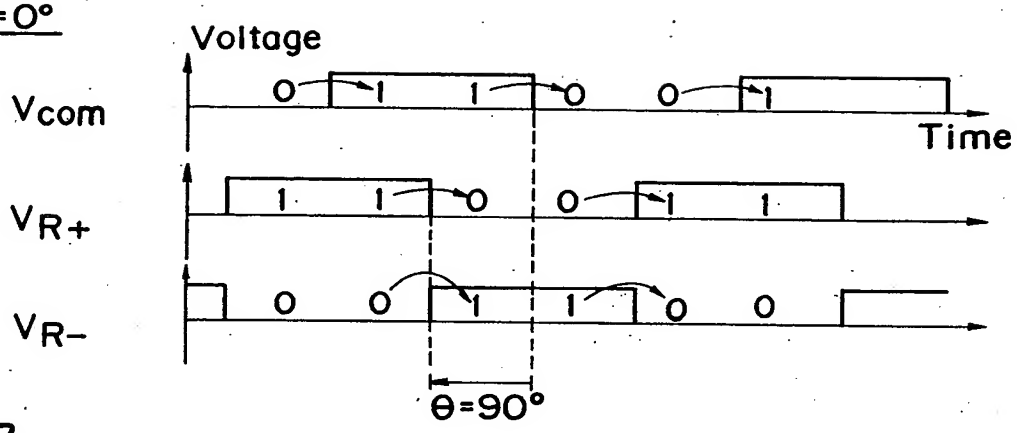

Fig. 10B

θ=90°, α=45°

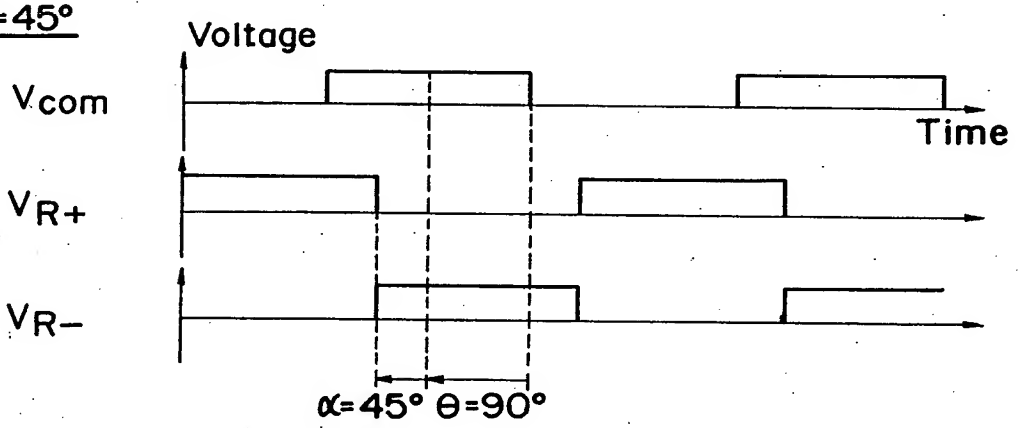

Fig. 10C

θ=90°, α=90°

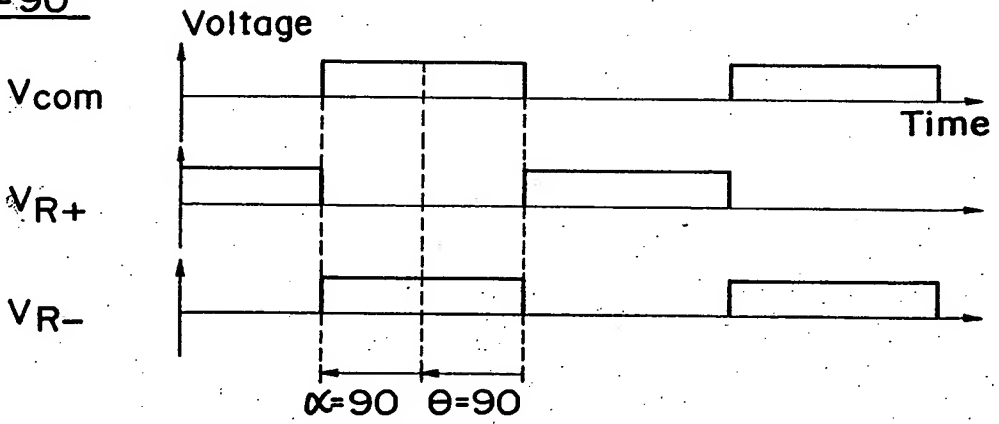

Fig.11A

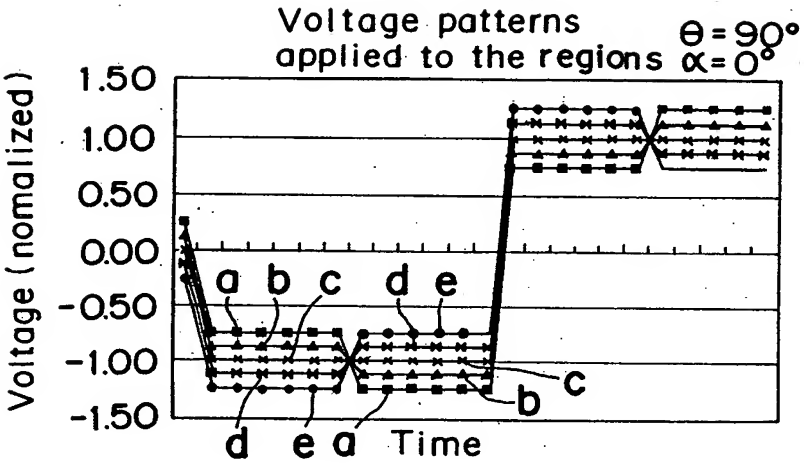

Fig.11B

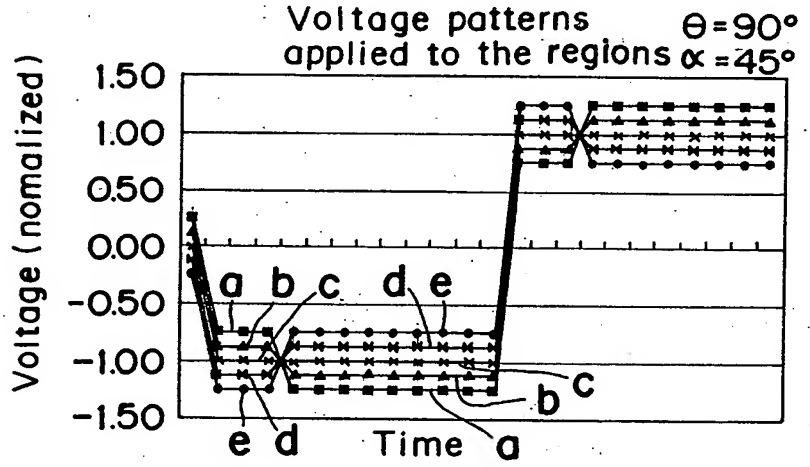

Fig.11C

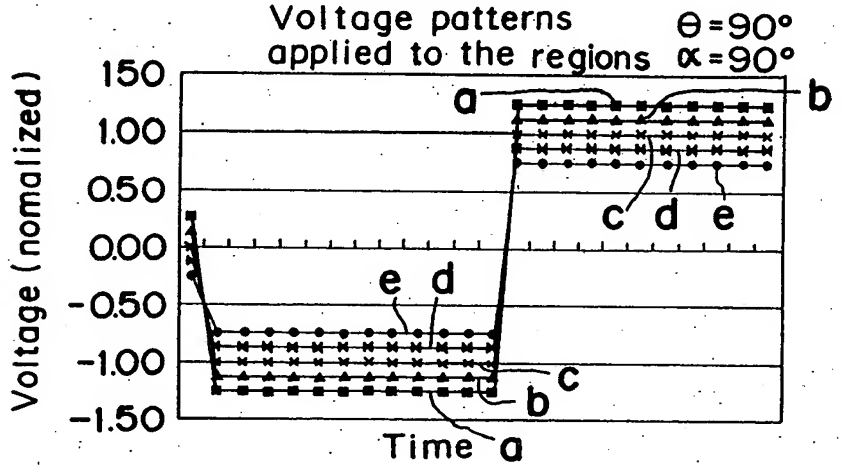

Fig. 12A

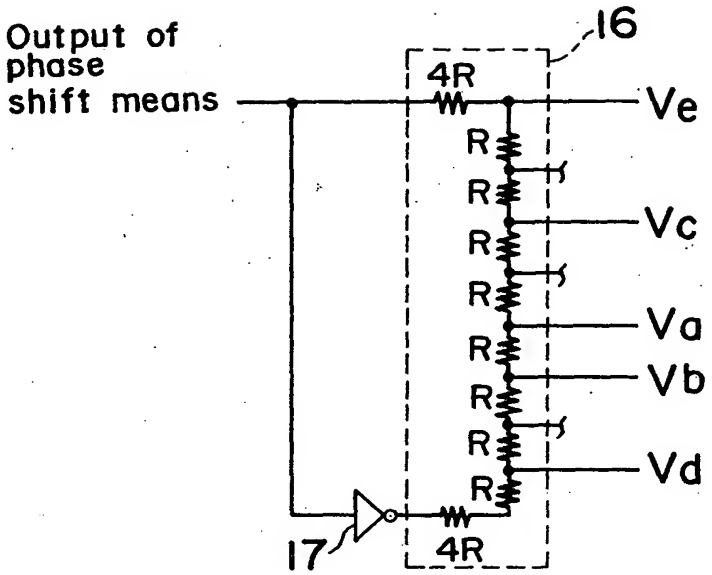

Fig. 12B

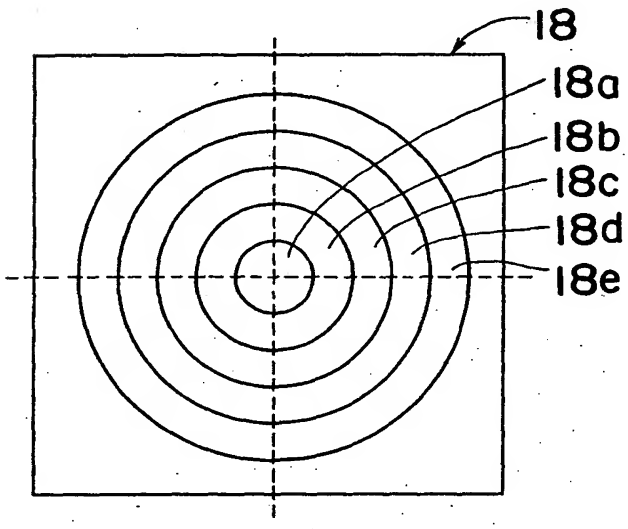

Fig. 12C

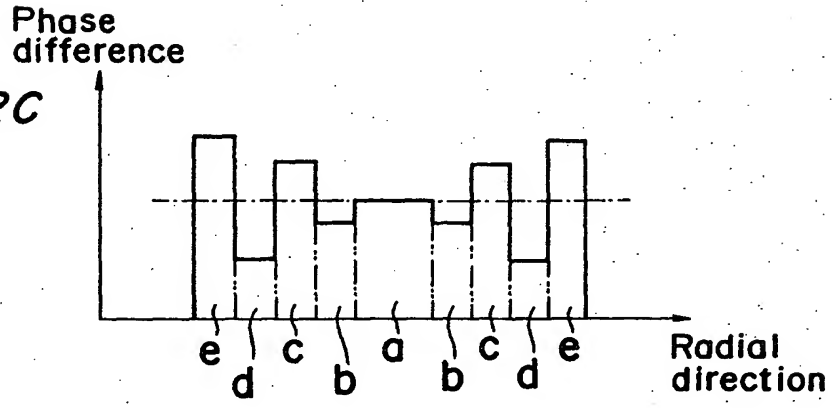

Fig. 13

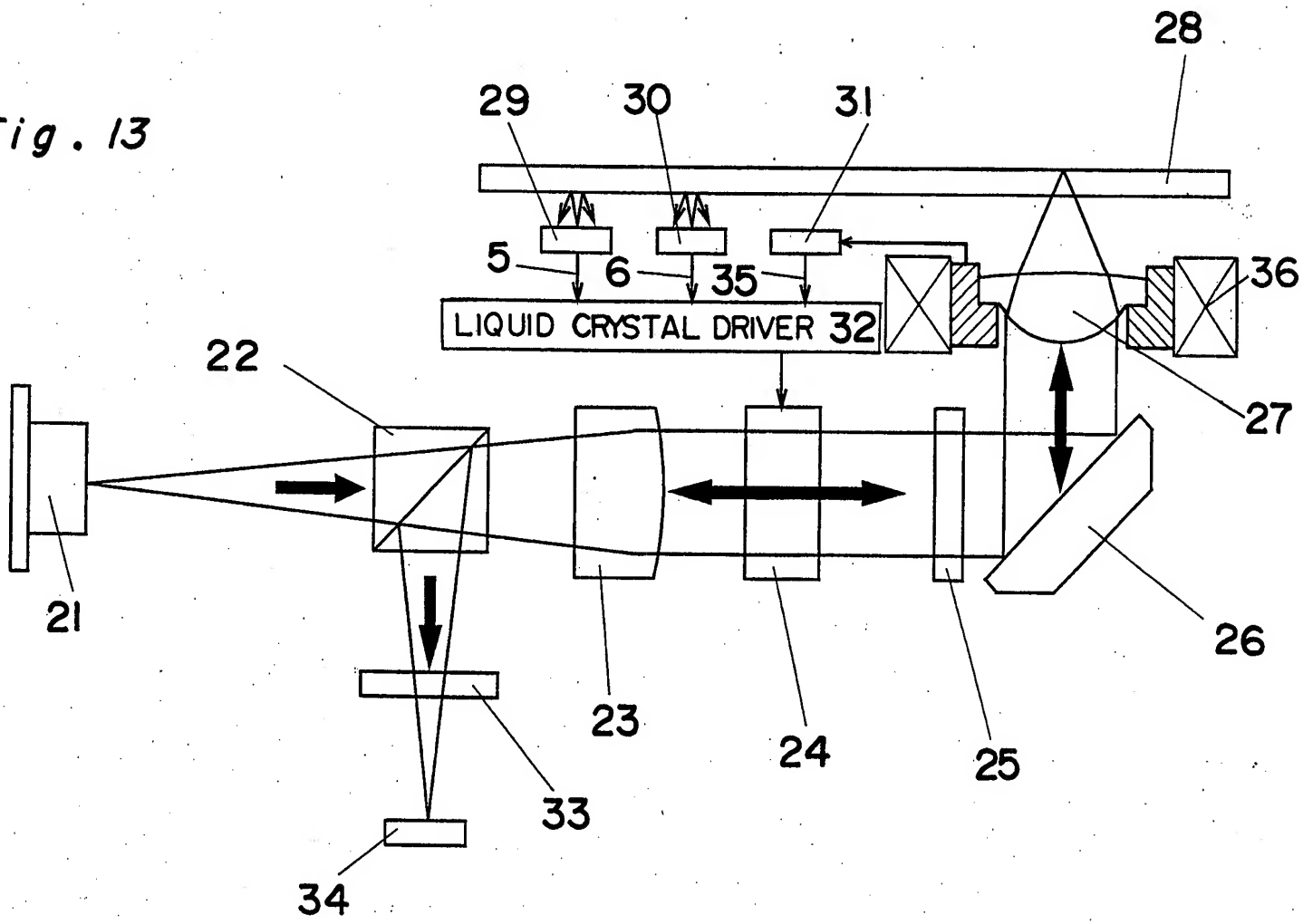
28
29
30
31
5
6
35
LIQUID CRYSTAL DRIVER 32
36
22
27
21
26
23
24
25
33
34

Fig. 14

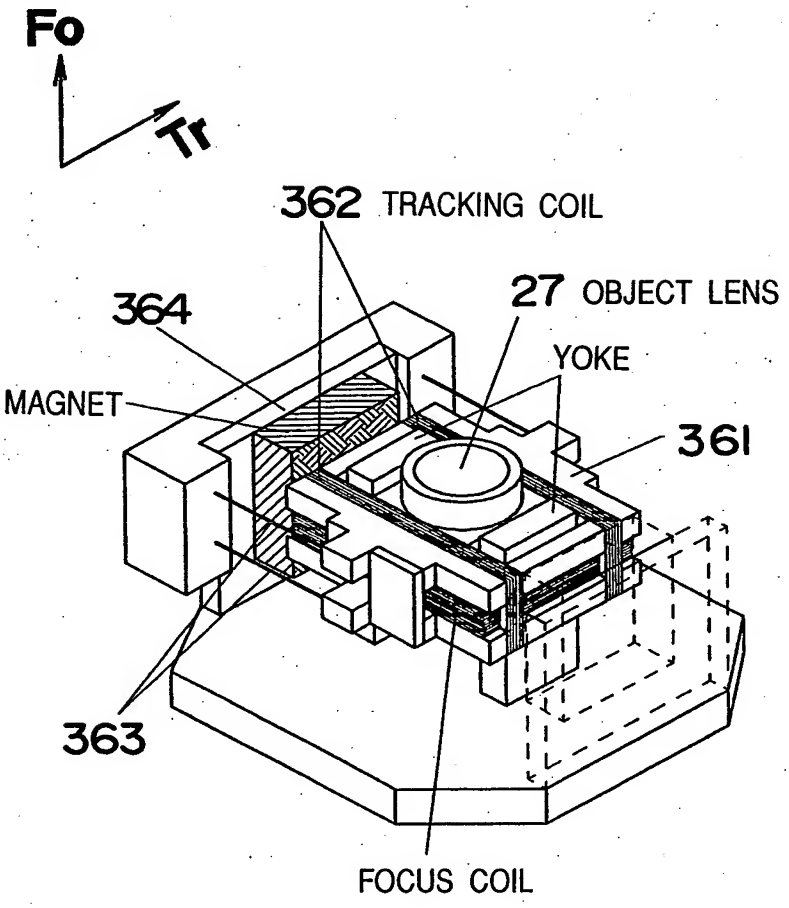
Fo
Tr
362 TRACKING COIL
27 OBJECT LENS
364
YOKE
MAGNET
361
363
FOCUS COIL

Fig. 15A

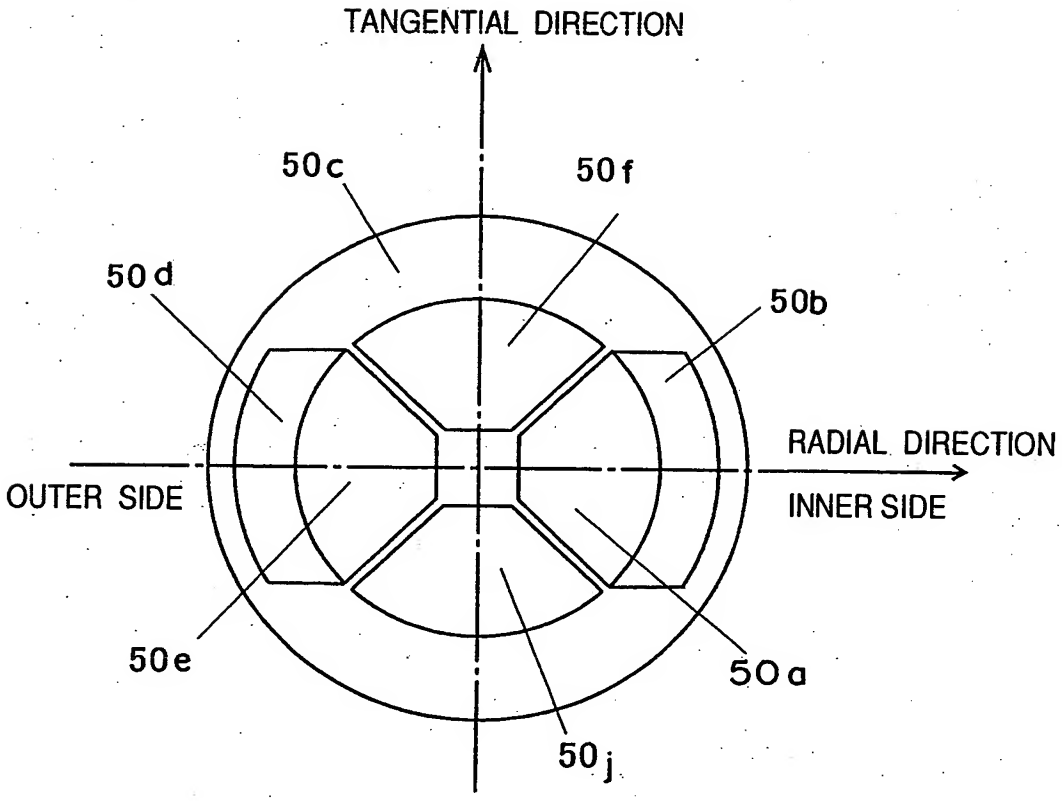

Fig. 15B

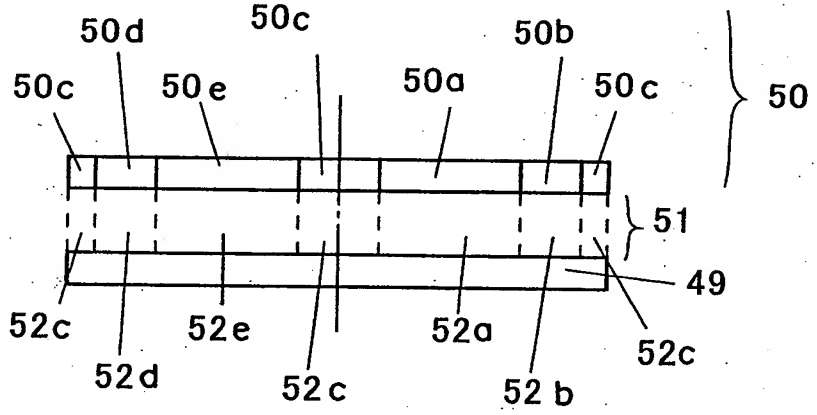

Fig. 16

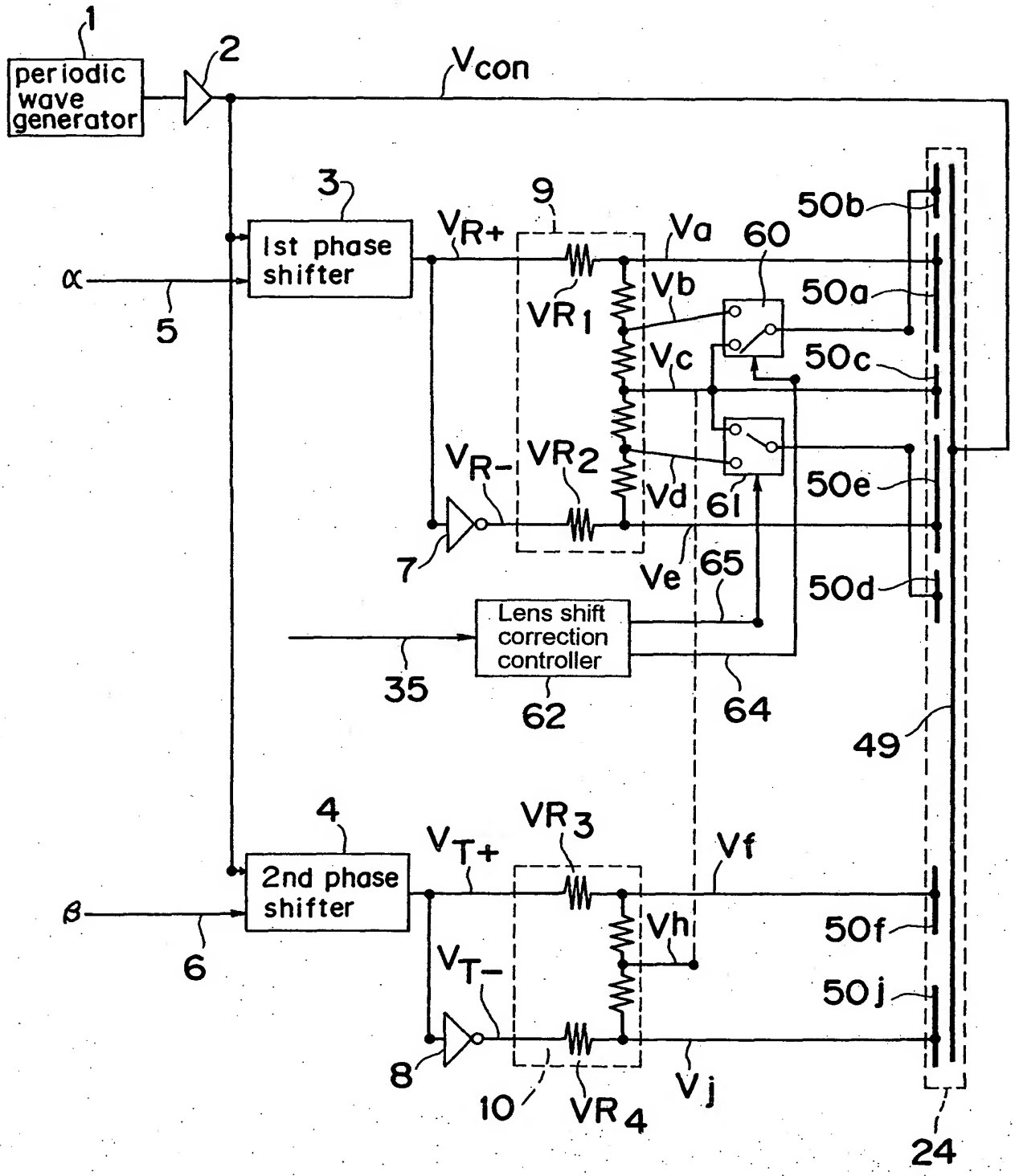
1
periodic wave generator
2
Vcon
3
1st phase shifter
α
5
9
VR+
VR1
Va
60
Vb
50b
50a
Vc
50c
VR-
VR2
Vd
61
50e
7
Ve
65
50d
Lens shift correction controller
35
62
64
49
4
2nd phase shifter
β
6
VT+
VR3
Vf
Vh
50f
VT-
50j
8
10
VR4
Vj
24

Fig. 17

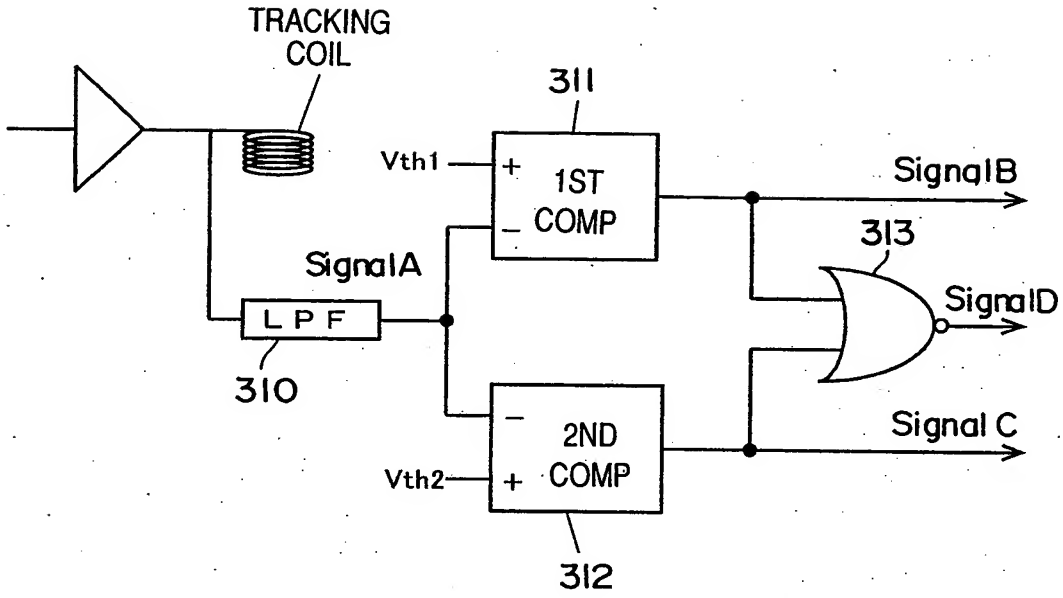
TRACKING
COIL
311
Vth1
+
1ST
COMP
−
Signal B
313
Signal A
L P F
310
Signal D
−
2ND
COMP
+
Vth2
Signal C
312

Fig.18A

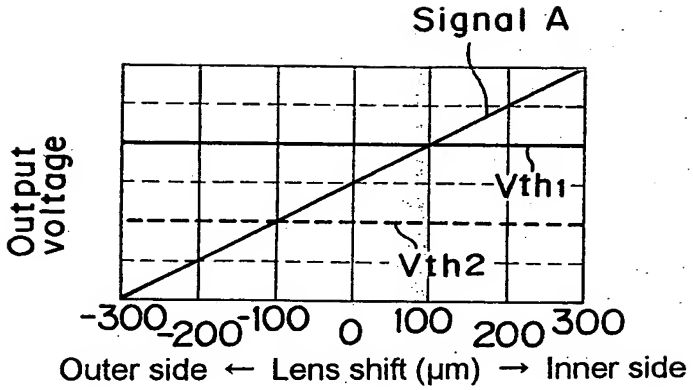

Fig.18B

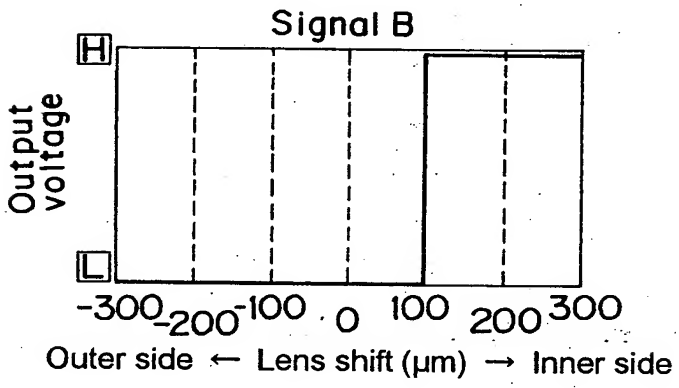

Fig.18C

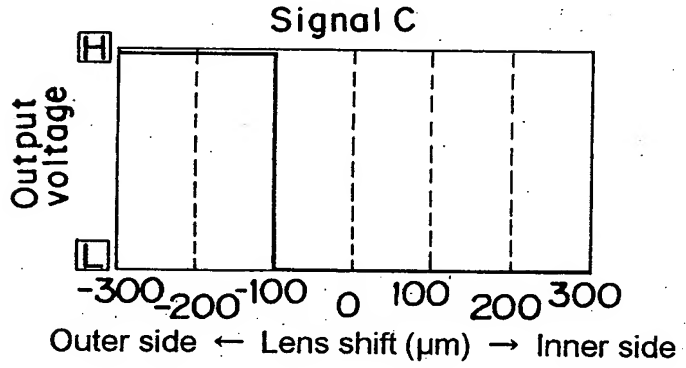

Fig.18D

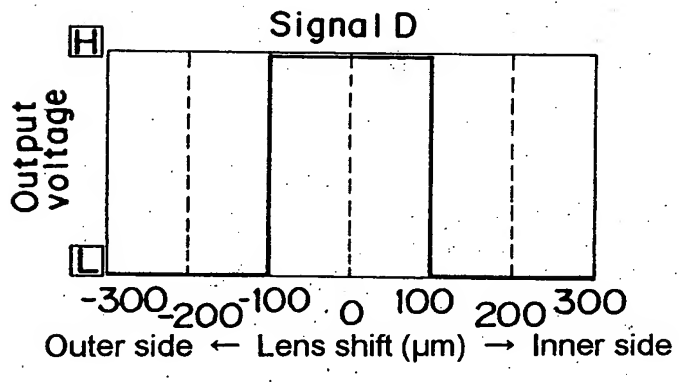

Fig. 19

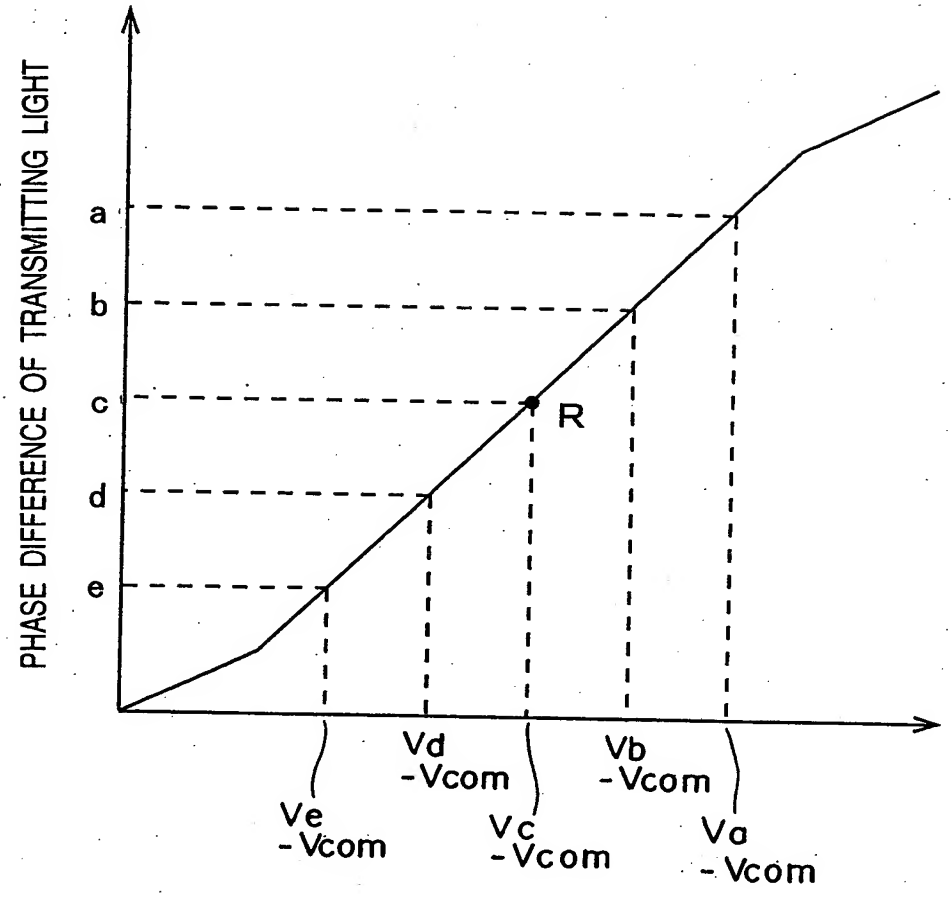
PHASE DIFFERENCE OF TRANSMITTING LIGHT
a
b
c
d
e
R
Ve
-Vcom
Vd
-Vcom
Vc
-Vcom
Vb
-Vcom
Va
-Vcom
EFFECTIVE VOLTAGE APPLIED TO
LIQUID CRYSTAL ELEMENT

Fig.20A

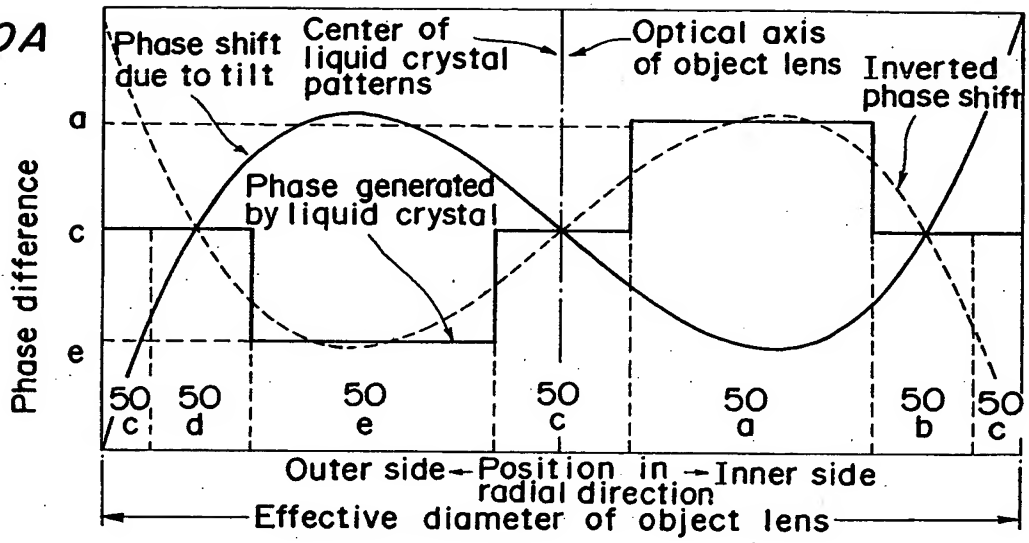

Fig.20B

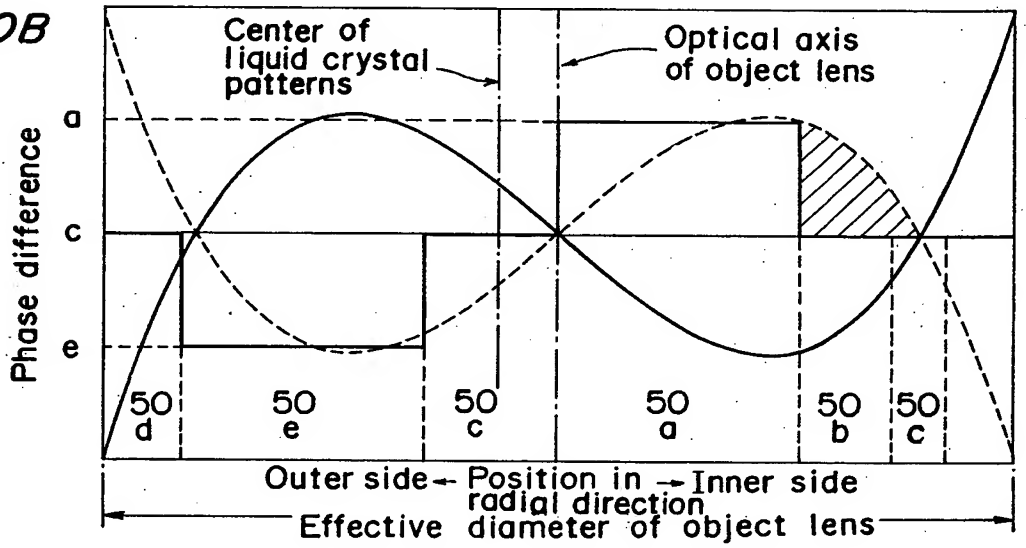

Fig.20C

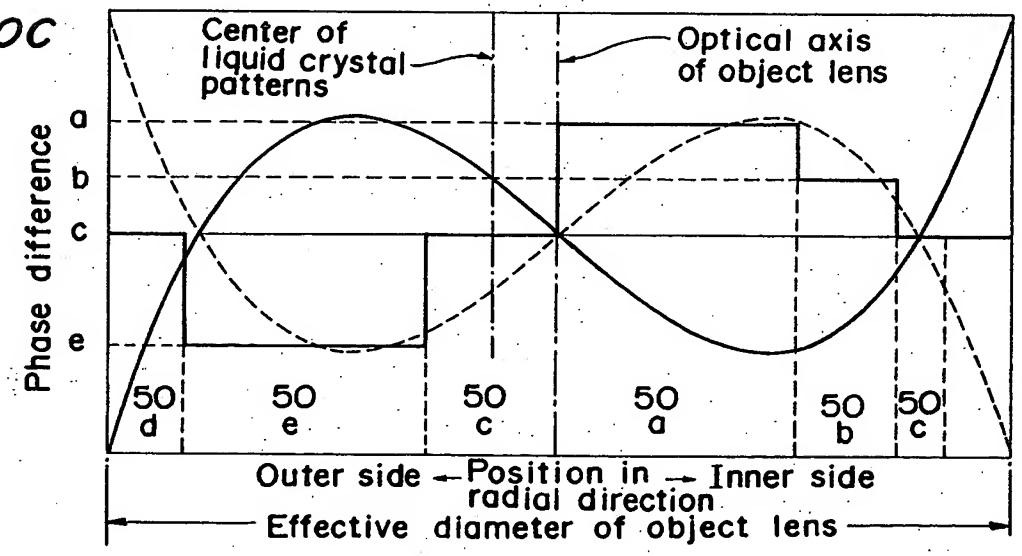

Fig. 21

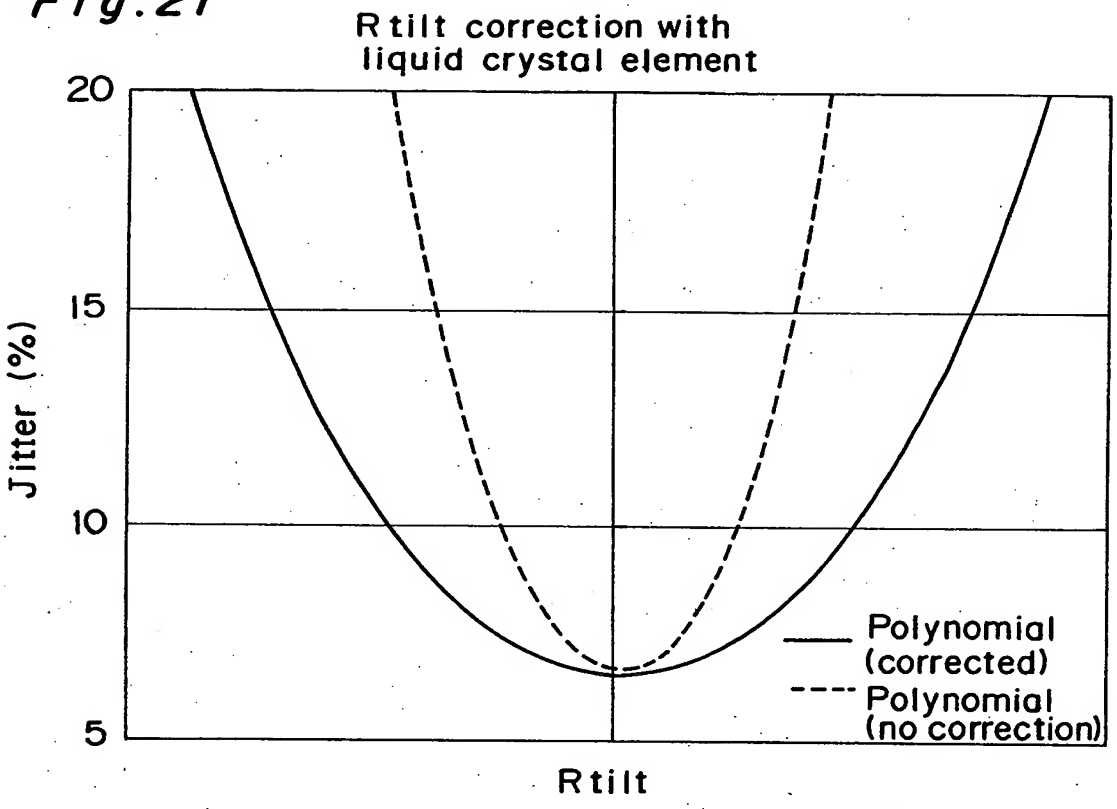
R tilt correction with
liquid crystal element
20
15
10
5
Jitter (%)
Rtilt
Polynomial
(corrected)
Polynomial
(no correction)

Fig. 22

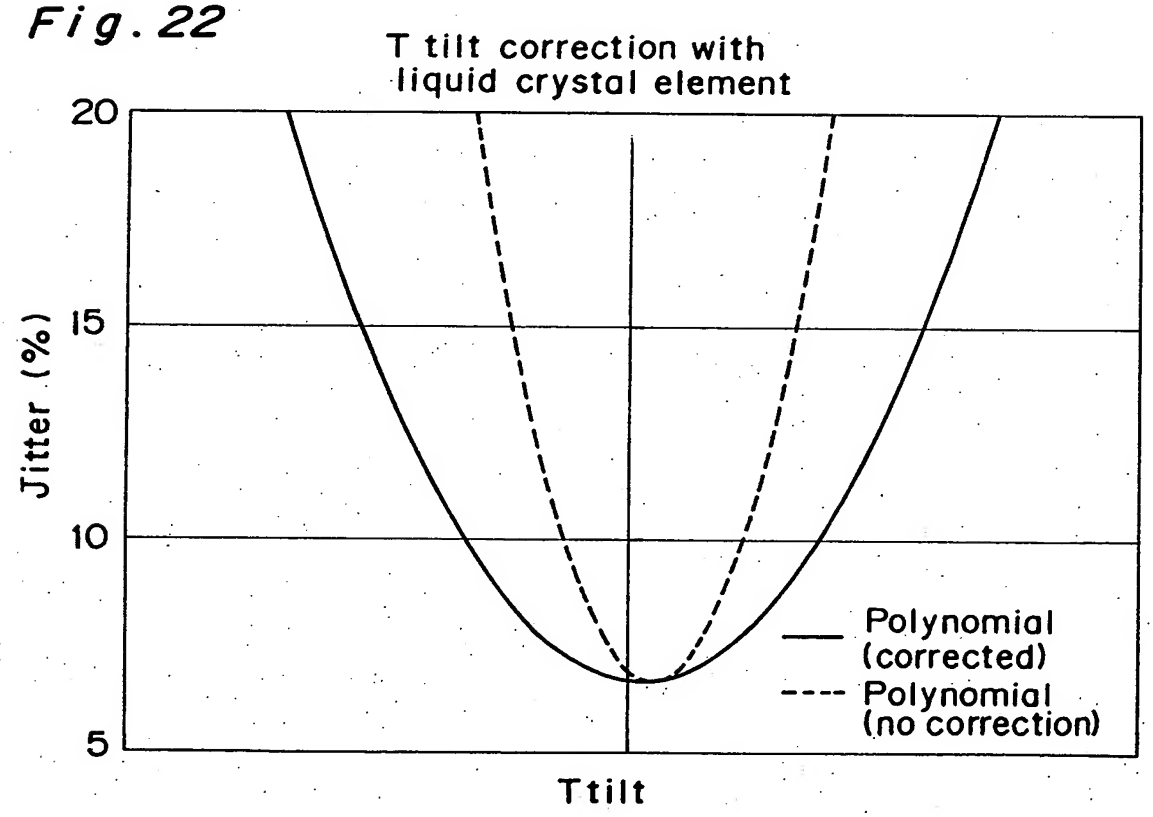
T tilt correction with
liquid crystal element
20
15
10
5
Jitter (%)
Ttilt
Polynomial
(corrected)
Polynomial
(no correction)

Fig. 23

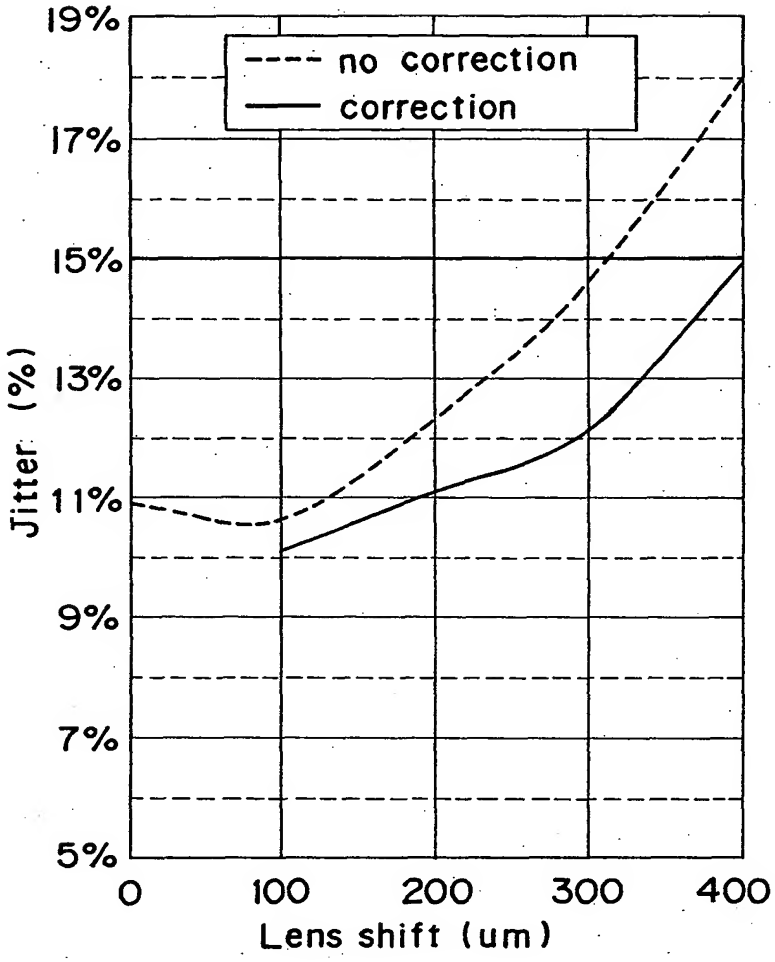
19%
17%
15%
13%
11%
9%
7%
5%
Jitter (%)
no correction
correction
0
100
200
300
400
Lens shift (um)

Fig.24A

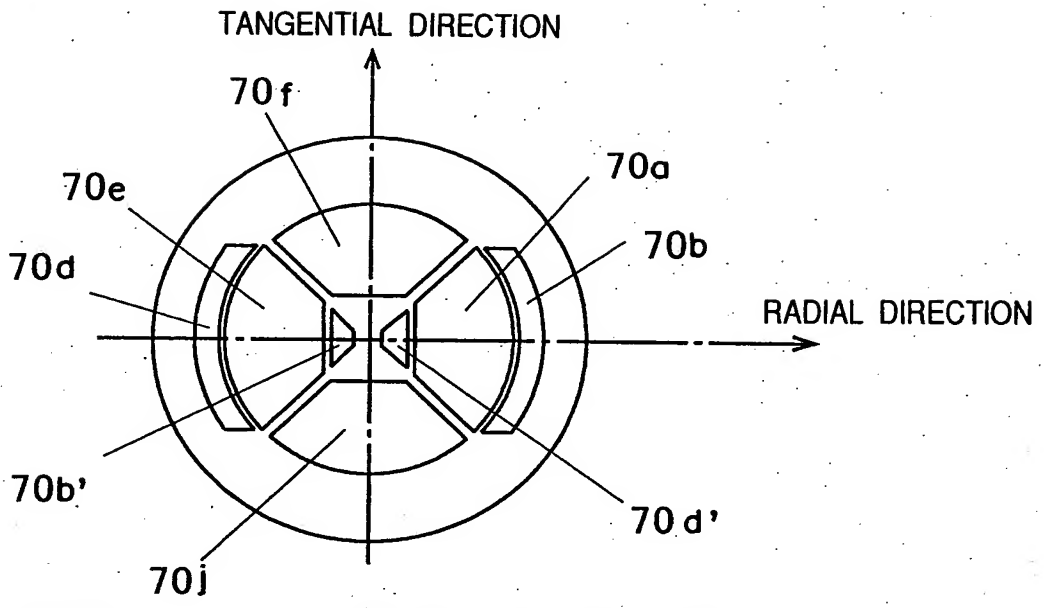

Fig.24B

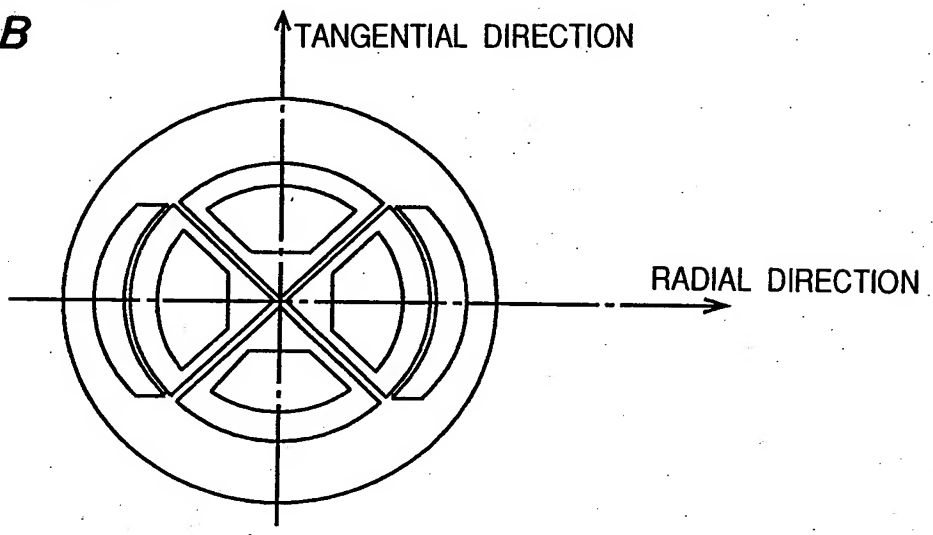

Fig.24C

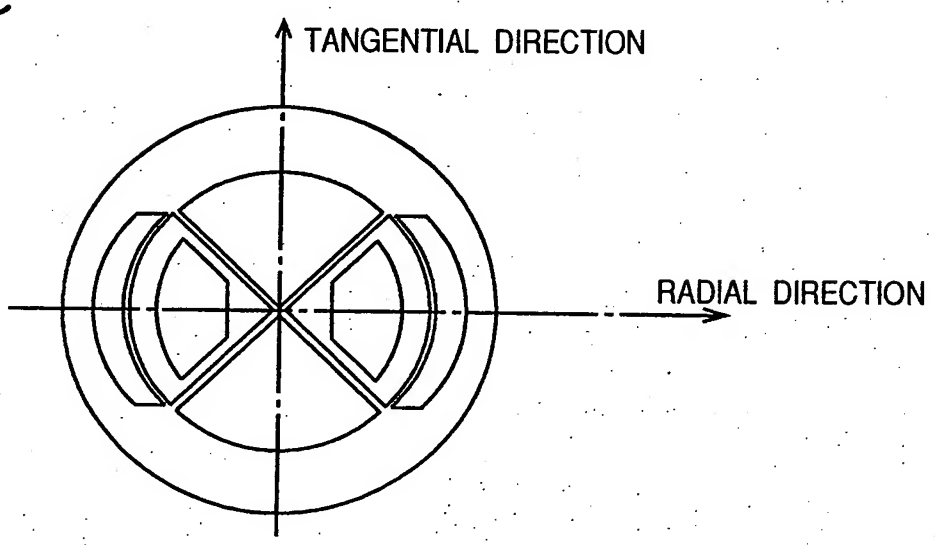

Fig.25A

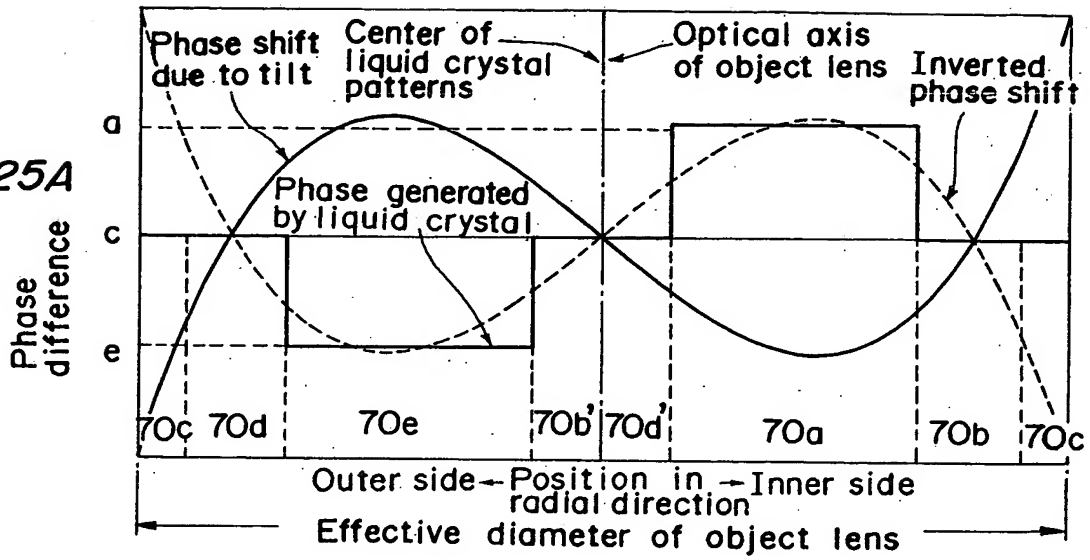

Fig.25B

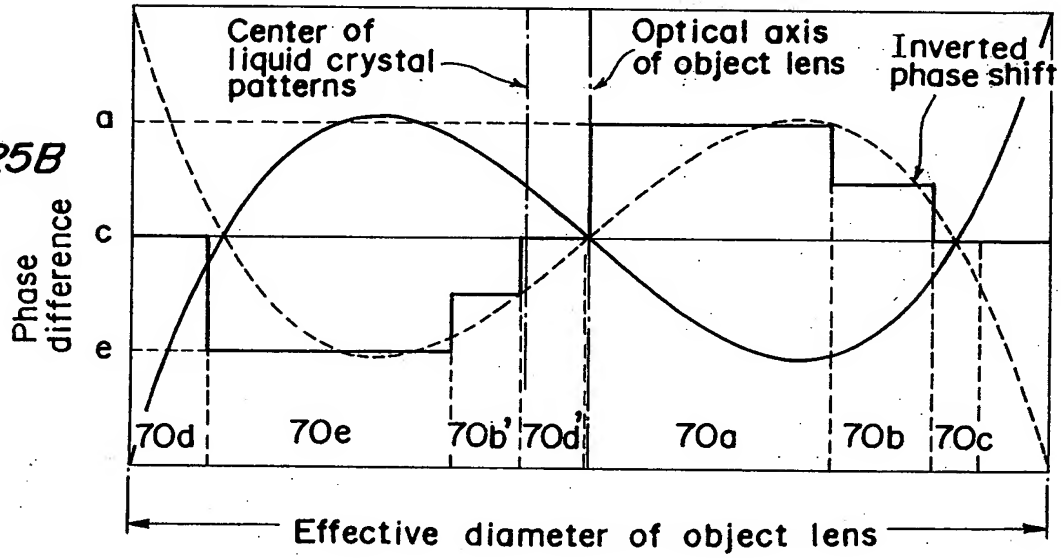

Fig.25C

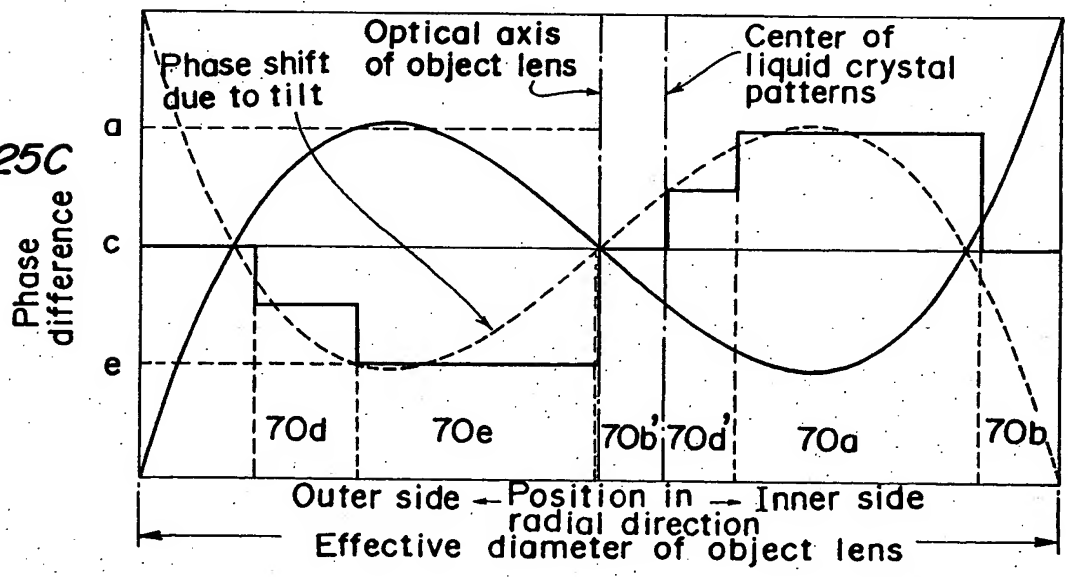

Fig .26A

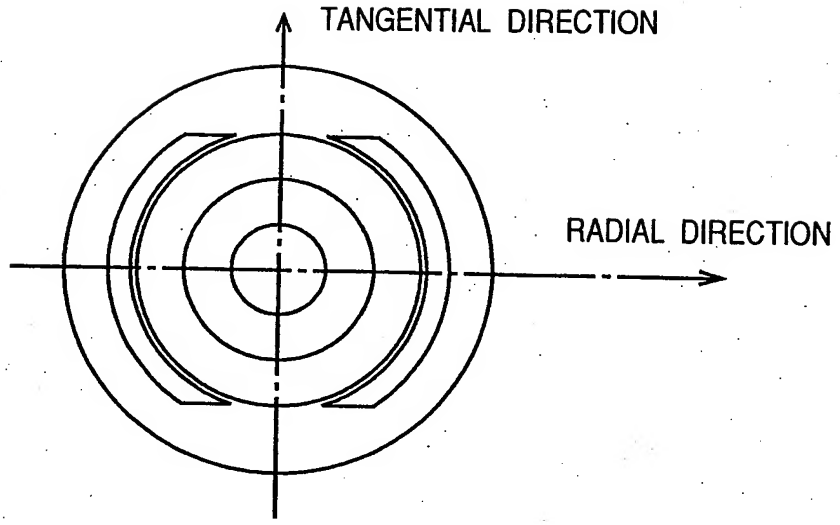

Fig .26B